Experiments to Understand Nuclear Weapon Performance

Benefiting from nearly four decades of nuclear testing, Livermore scientists and engineers vastly improved the performance and safety of weapon systems that comprise the nation's nuclear deterrent. In the absence of nuclear testing, decisions and actions about the stockpile still must be grounded in experimental reality. To ensure stockpile performance today, nonnuclear experiments—coupled with advanced computer simulations—are used to achieve a highly sophisticated understanding of underlying physics and engineering issues.

Dedication of the Contained Firing Facility

In August 2001, more than 200 dignitaries, employees, and community guests participated in a dedication of the new Contained Firing Facility (CFF) at Site 300, an experimental test area 24 kilometers southeast of the Laboratory's main site. Participants included NNSA Administrator General John Gordon, UC Vice President for Laboratory Management John McTague, and NNSA's Oakland Operations Manager Camille Yuan-Soo Hoo.

The CFF houses the Laboratory's most modern capabilities for conducting hydrodynamics tests. In these critically important experiments for stockpile stewardship, scientists study the performance of mock weapon primary pits as they are imploded by high explosives. With construction of the firing chamber completed, the debris from test explosions is contained in a more environmentally benign manner than ever—dramatically reducing particle emissions and minimizing the generation of hazardous waste, noise, and blast pressures.

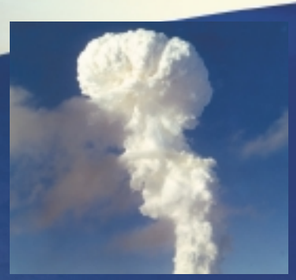
In an area 16 by 18 meters and standing 10 meters high, the firing chamber is designed to withstand repetitive tests that use up to 60 kilograms of high explosives (equivalent to 2,000 hand grenades). Walls are up to 2 meters thick and protected from shrapnel by 50-millimeter-thick steel plates. Construction required as much concrete and steel as the frame of a typical 60-story office building. Ventilation, filters, and a water wash-down system clean the chamber after each experiment and effectively manage generated waste.

In addition to the new firing chamber, the CFF houses one of the world's most capable x-ray radiography machines, a complete suite of diagnostic equipment, and a staging area for experimental preparations. "Core punch" experiments probing the detailed shape of the gas cavity inside a pit when it is highly compressed were first conducted at this bunker in the 1980s. Major improvements were made during the 1990s, including the introduction of digital imaging techniques. Before suspension of operations for CFF construction, these experimental capabilities were used to carry out the first core punch experiments on two types of stockpile weapons: the W76 SLBM warhead and the B83 strategic bomb.

1950s

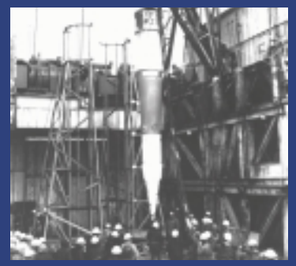
Six months after opening, Livermore conducted its first nuclear test, RUTH, to explore a novel design concept. It fizzled. However, subsequent tests led to development of the Polaris warhead and included the first contained underground nuclear explosion, RAINIER. That experiment paved the way for an atmospheric test ban.

1960s



After the Soviets broke a moratorium, the U.S. resumed nuclear testing and scientists conducted their last atmospheric tests in 1962. Rapid advances in nuclear design benefited from frequent underground tests and newly developed capabilities at Livermore that included radiographs of imploding mock weapon pits in nonnuclear hydrodynamics tests.

1970s



Described as being under 5 megatons, CANNIKIN set many records when successfully executed at Amchitka Island, Alaska, in 1971. The experiment, weighing over 400 tons, was lowered down a hole 6,150 feet deep and 90 inches in diameter. Its many technical breakthroughs in nuclear-test equipment and extensive diagnostics accentuated a continuing trend.

1980s

Livermore conducted many of its most complex nuclear tests and markedly improved its nonnuclear experimental capabilities. The Laboratory brought into operation its High-Explosive Applications Facility for work on energetic materials, the Flash X-Ray Facility for hydrodynamics testing, and the Nova laser for inertial confinement fusion experiments.

1990s

With a U.S. moratorium on nuclear testing, the Laboratory dramatically increased its reliance on nonnuclear testing as part of the Stockpile Stewardship Program. Many new experimental capabilities, including the fielding of subcritical experiments at the Nevada Test Site, help researchers to better understand how plutonium ages.